NEC and IEC 60364 Comparison and Contrast

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The following is a summary of the material contained within the document *Electrical Installation Requirements, A Global Perspective (April 1999)*, prepared by Paul Duks, Underwriters Laboratory (UL). This report was commissioned by the National Electrical Manufacturers Association (NEMA™) as an effort to compare the material contained within the National Electrical Code (NEC®) and the IEC 60364. Funding for this study came from NEMA, the National Fire Protection Association (NFPA), UL and the National Institute of Standards and Technology (NIST). IEC provided funding for David Latimer (IEC T64 chairman).

The study underwent peer review by the following individuals:

Mark Earley, NFPA
Ken Gettman, NEMA
David Latimer, IEC TC64 Chairman
Francois Martzloff, NIST
John Minick, NEMA
Bob McCullough, IAEI, Ocean County Construction Inspection Department
George Ockuly, Cooper Bussmann
Jim Pauley, Schneider Electric
Jack Wells, Pass & Seymour Legrand
John Young, Siemens

This summary was commissioned by Richard Candee, Assistant Vice President, NFPA International Operations, and was prepared by Ed Comeau, writer-tech.com. The sources of information used in this document are comprised of a PowerPoint presentation prepared by Jim Pauley (provided to Comeau by NFPA), a report prepared by Paul Duks for Underwriters Laboratory, information from the NEMA web site and personal communications with NFPA staff. Most of the information was gathered from the Duks report. It is noted in the text when information was obtained from other sources.

A comparison of the NFPA National Electrical Code (NEC) and IEC 60364

Two documents serve as the basis for electrical wiring in 90% of the world, according to a report prepared by Underwriters Laboratory.

- National Electrical Code (NEC) published by the National Fire Protection Association (NFPA)
- IEC 60364 published by the International Electrotechnical Commission.

The NEC was developed based on a need in North America to standardize the installation of electrical systems as they were being developed. The NEC therefore evolved, historically, as systems and technology progressed. The NEC contains mandatory language that allows for use by designers, installers and AHJ's to ensure that adequate safety levels are met. It covers a wide range of requirements, including hazardous locations (explosive atmospheres), which IEC 60364 does not.

On the other hand, IEC 60364's purpose is to only provide guidance. Efforts were made to harmonize the electrical installation requirements in 1969, but these efforts were unsuccessful because of the large number of differences between the various systems prevalent throughout Europe. The result, therefore, was a document (IEC 60364) that provided guidance to an authority on developing national wiring principles that would, in turn, serve as the basis to further develop practices, such as are outlined in the NEC. As stated in a report prepared by Underwriters Laboratory, "Countries adopting IEC 60364…need to develop additional rules usable by electrical system designers, installers, and enforcing authorities."[i]

The NEC is in use in all 50 states in the United States. Countries that have formally adopted the NEC include Mexico, Costa Rica, Venezuela and Columbia. Many countries in South America use the Code, and it has been translated into Spanish, Korean and Japanese. (Candee, Keith, Bunker)

The NEC has a regular, three-year cycle for updating its material. There are 478 people on 20 NEC code-making panels involved in a rigorous review of the material contained within the NEC and ensuring that it reflects the current state of the art. (Bunker)

Revision of IEC 60364 is not done on a regular timetable, as with the NEC. It is a collection of 38 documents and 10 amendments, all of which have varying publications date. There are some documents contained within IEC 60364 that have not been updated since being issued in 1977.

The NEC does not limit specific voltage requirements for an installation. The IEC, on the other hand, does limit its scope to the installation of circuits up to 1,000 V. Such limitations, the report states, "this could be a serious consideration for high-rise building installations."

The report outlines some of the difficulties involved with using IEC 60364 because of the layout of the document. Requirements are located throughout a number of chapters, some of which contain information that was issued in 1977, for example. (An amendment was appended to this chapter, however, to delete the references to some of the outdated information.) The report goes on to further state "rules which cover one safety feature are located in different parts of the documents."

Furthermore, because IEC 60364's rules stop at the socket outlet, it does not take into account the overcurrent protection that may be required for current-using equipment, as does the NEC. This could result in "inappropriate or hazardous installations" when using IEC 60364.

Even though it would be necessary to make some adjustments in the NEC because of metric conversions and the use of 240 V systems versus 120 V systems, the report goes on to say that "from the standpoint of uniform application and enforcement, the NEC, with its comprehensive requirements, would be a more appropriate base document for development of national wiring rules." Few changes would be necessary

to adopt the NEC because it is designed as a model code, suitable for adoption.

IEC 60364 is not designed as a model code document. This document only provides the authority with guidance on developing national wiring rules-it is not the code itself, as with the NEC. Another document, compatible with IEC 60364, must be developed to provide these rules.

Duk's report also states, in relation to adoption:

> "The IEC 60364 standard on *Electrical Installations of Buildings* is intended to serve as a model for development of national requirements. It has been characterized as not being suitable for direct adoption as an installation practice. Due to its composition, layout, and inclusion or recommendatory and advisory provisions, **effort is needed to create documents that include mandatory installation language which can be uniformly applied.**" (emphasis added)

For example, this process is being undertaken in Britain where a European version of IEC 60364 exists (HD 60384). The British Institution of Electrical Engineers (IEE) then had to develop BS7671, *Requirements for Electrical Installations*, based on the material contained within HD 60384. Furthermore, IEE then developed an *On-Site Guide to BS 7671*, which is the actual document used by installers and verifiers. However, this guide does not cover all installations. For installations that are not contained within the *Guide*, the user must then refer to the original source document, BS 7671.

It is important to note that there are many common factors between the two documents and, according to Merton Bunker, NFPA's Chief Electrical Engineer, the NEC is compatible with IEC 60364. NEMA also states that the report "highlights more similarities than differences,"

In a Tentative Interim Amendment (TIA) to the NEC,

Reference: 90-1 (d) (New)
TIA 99-1

(d) **Relation to International Standards.** The requirements in this *Code* address the fundamental principles of protection for safety contained in the International Standard "Electrical Installations of Buildings, IEC 60364-1, Section 131.

FPN: IEC 60364-1, Section 131 contains fundamental principles of protection of safety that encompass: protection against electric shock, protection against thermal effects, protection against overcurrent, protection against fault currents, and protection against overvoltage. All of the above potential hazards are addressed by the requirements in the *Code*.[ii]

Jim Pauley states, "The NEC has been amended to link its safety practices and procedures with those of the fundamental principles of the IEC document."[iii]

In comments made by David Latimer (IEC TC64 chairman) as part of the report, he says:

"The guidance can be divided into two classes, one of which is broad guidance, expanding upon the principle, and for the assistance of the senior designer engaged in large or difficult installations. The other is 'do it this way' guidance. The NEC is a 'do it this way' document. It has a broad scope and covers the widest possible range of situations. I believe that installations carried out to the NEC will comply with the requirements of IEC 60364. Without doubt, they comply with Chapter 13."

He goes on further to state:

"The point is made in the report that because of the limited experience of national committees and delegates to TC64 in 110 volt systems, the requirements of IEC 60364 do not fully reflect the needs of such systems. This may be possibly so. I would welcome any indication of the way in which IEC 60364 might be amended to meet these needs, thus enabling IEC 60364 to be adopted by ANSI as a U.S. standard, with the NEC as a 'means to comply' document for those countries that wish to use it."

NEC	IEC 60364
IEC evolved along the 100 year development of lectrical systems in the US	IEC 60364 began as a process of harmonization of existing rules in European countries to facilitate trade
IEC is a set of specific rules intended to be used or design, installation and uniform enforcement f electrical system installations based on North merican principles and practices	IEC 60364 is a collection of documents that define fundamental principles, practices and performance requirements that have their basis in the European concept of wiring and distribution systems
IEC and IEC 60364 both establish performance equirements that address fire and electric shock rotection, i.e., protection of persons and roperty.	
IEC and IEC 60364 both address installation, se and maintenance of premises wiring systems nd equipment	
IEC and IEC 60364 are both applicable to iring systems of premises for residential, ommercial and industrial use. Hazardous ocations	
IEC covers hazardous locations (explosive tmospheres)	IEC 60364 does not cover explosive atmospheres (covered separately in IEC 60079).
Neither document covers installations for eneration, transmission or distribution of lectrical energy	
Neither document covers installations under the xclusive control of electrical or communications tilities	
IEC is a comprehensive set of electrical nstallation requirements that can be adopted and nplemented without the development of dditional wiring rules	IEC 60364 provides broad performance requirements and is NOT usable as an installation document by electrical systems designers, installers or enforcing authorities. Rather, it can serves as a guide for the development of national wiring rules. Countries adopting IEC 60364 in whole (or only Chapter 13, Fundamental Principles) need to develop additional rules usable by electrical system designers, installers and enforcing authorities.
IEC and IEC 60364 need effective coordination ith appropriate product standards to be uccessful in implementing electrical safety. [iv]	

	NEC	IEC 60364
Adoption	Model code intended for legal adoption or reference by countries, states, counties, cities, etc.	Intended to serve as the basis for the development of national requirements.
Revision Cycles	Regular, 3-year cycle	Continual, as determined by the technical committee
Language	Mandatory language	Mandatory language, but also contains much advisory material or recommendations
Requirements	Prescriptive	Performance-based
Product Standards	Lacks a solid (direct) tie to product standards. This is handled through coordination by the SDO's.	Has a direct tie to IEC product standards through direct reference.
Organization and Layout		
	Arranged by parts of the electrical installation (branch circuit, panelboard, overcurrent protection, etc.)	Arranged by element of protection (overvoltage, thermal effects, electric shock, etc.)
	No voltage limitation specified	Limited to 1,000 volts AC
	Covers all elements of the premises wiring system as well as some utilization equipment requirements	Coverage includes the premises wiring system, but stops at the outlet
	Addresses hazardous locations (explosive atmospheres)	Hazardous locations requirements are not contained in 60364 (contained in IEC 60079)
Suitability for Adoption	Designed to be legally adopted as the requirements for electrical installations	Provides a framework for development of an installation code. The fundamental principles are contained within Chapter 13.

Suitability for Enforcement	Suitable for mandatory enforcement by verification bodies	Intended to be the document upon which countries base their document.
	Contains mandatory requirements-no recommendations	Contains mandatory language, but also contains recommendations
	No design guidance	Compliance with some provisions can be agreed upon by the owner and the installer.
Existing Infrastructures	North America-120 V branch circuits (increased fault currents)	Europe-240 V branch circuits (higher touch voltages)
Systems	Both cover TN, TNC, TNCS, IT. Prohibits TT systems.	Both cover TN, TNC, TNCS, IT. Allows TT systems.

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[i] Duks, Paul. *Electrical Installations, A Global Perspective.* National Electrical Manufacturers Association, 1999.

[ii] NFPA 70, National Electric Code, 1999 edition

[iii] NEMA, http://www.nema.org/publications/ei/jun99/iec_nec2.html, June 1999

[iv] The source material for this table was taken from a PowerPoint presentation prepared by Jim Pauley and provided to writer-tech.com by NFPA. Actual text from the presentation was used in this table. NFPA is responsible for determination of further use of this content based on copyright requirements or issues (if any).

[v] ibid.